The determination and graphical representation of lateral fluvial channel migration rates using a raster approach

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Abstract

In fluvial geomorphology the evolution of a river channel is quantified using the displacement in the x, y and in the z direction. The data of the displacement is obtained in the x,y direction case, usually from cartographic or topographic measurement, at different intervals of time. The present research tries to setup a semiautomatic GIS method to calculate and represent the rates of lateral migration of a river channel using a raster approach. First two vector datasets representing two positions of a channel river at two different times are converted to raster at a random resolution. Using a thinning raster filter, a central raster line of the channel is obtained. Then a distance raster is created, which will be used for the graphical representation of the rates of lateral channel migration at a distance equal with the resolution. Finally this distance raster may be used for plotting the rates on a graph.

***Key words**: Fluvial, lateral channel migration rates, raster, vector, thinning filter, distance raster,*

Lateral fluvial channel migration rates

In fluvial geomorphology the evolution of a river channel is studied using different temporal situations from topographic maps or from remote sensing images. This approach quantifies several parameters that describe the horizontal evolution of the river channel. The rate of lateral migration of a river channel is one of them.

The vector datasets

The two vector datasets represent the Siret river channel and are extracted from 100k topographic maps. First temporal datasets is extracted from the 1966 topographic maps edition and the second from the 1974 edition. Geographically (figure 1), the vector datasets show the Siret channel from the 11.5 km of Romanian-Ukrainian border (km 0) to the 32th km downstream.

Raster processing methodology

The two vector datasets need to be converted to raster using a grid with 10 m resolution in our case (Figure 2). The resulting raster, is 2 bits coded, with 0 value for non-river channel pixels, and value 1 for the river channel pixels. Then, this raster is thinning filtered, transforming the value 1 to 0 until we obtain a continuous line of neighborhood pixel with value 1. Finally one of the rasters is vectorized to obtain the

centerline of the channel, and the other is transformed in a distance raster (Figure 3). The pixel of the distance raster represent the distance from the center pixel of the river centerline (0) to that pixel (in meters), in both sides (E-V, left-right).

The processes mentioned up can be made with almost every GIS software package. In this case we used TNTMips from Microimages Inc.

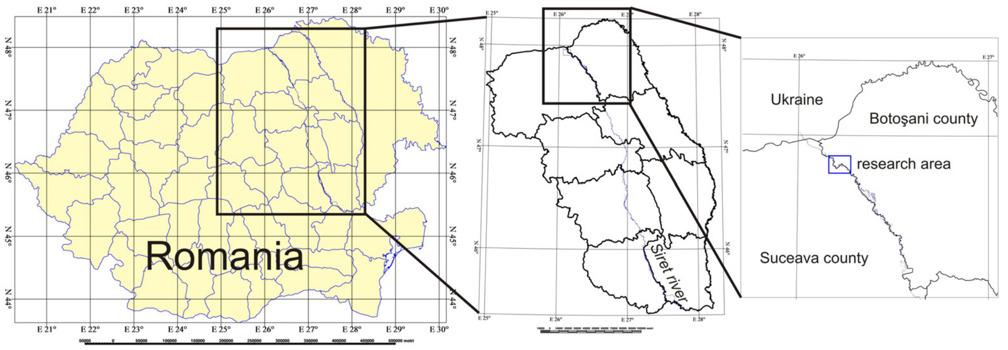

Figure 1. Position of vector datasets

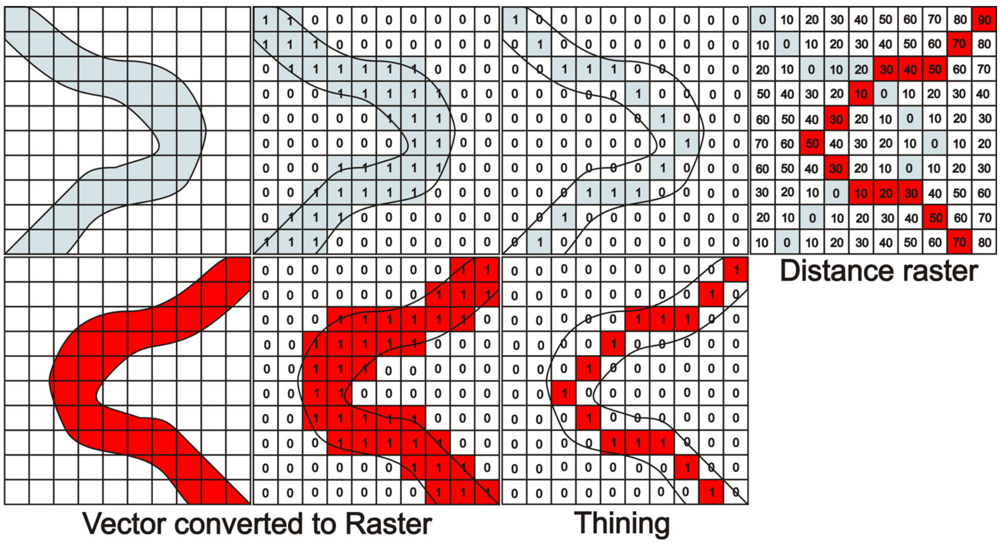

Figure 2. Raster processing

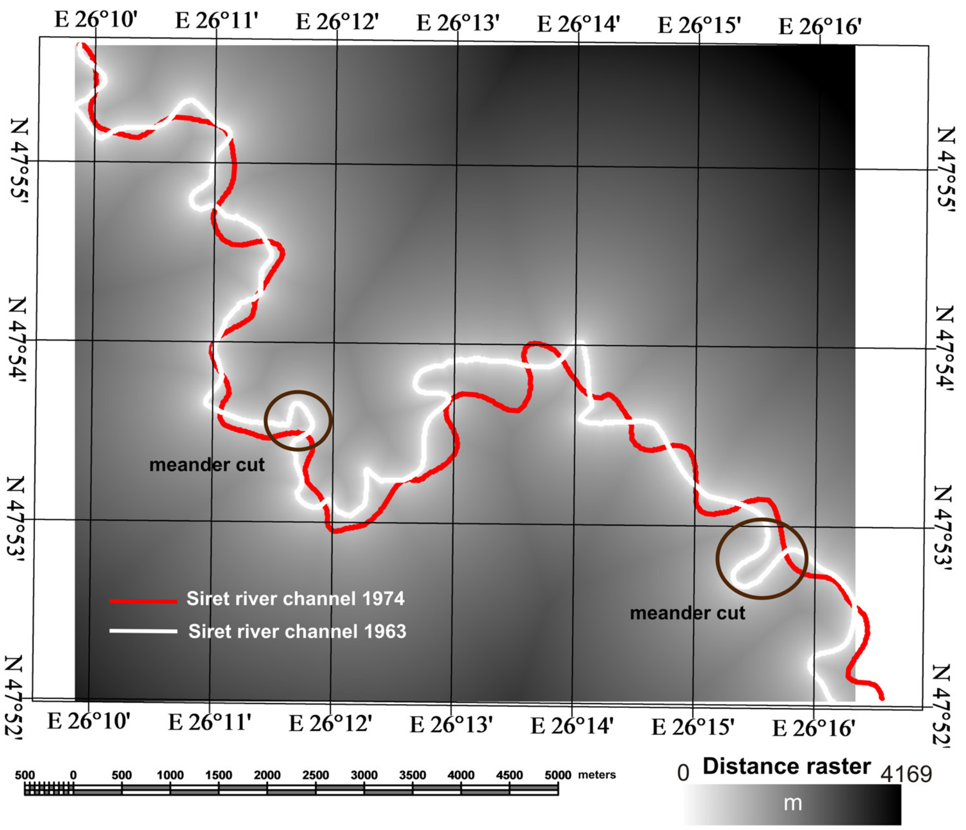

Figure 3. The distance raster with the vector datasets

Graphical representation

The first graphical representation is a raster map (figure 4) showing the rates as a function of distance raster between the two channel position. The single problem appears in the areas of meander cut, where the distances are false.

The second graphical representation is a plot graph (figure 5), with ox axis showing the distance along the channel river from 0 (11,5) km to the 20,5t^{h} (32) km, and with oy axis showing the rates of channel migration in meters.

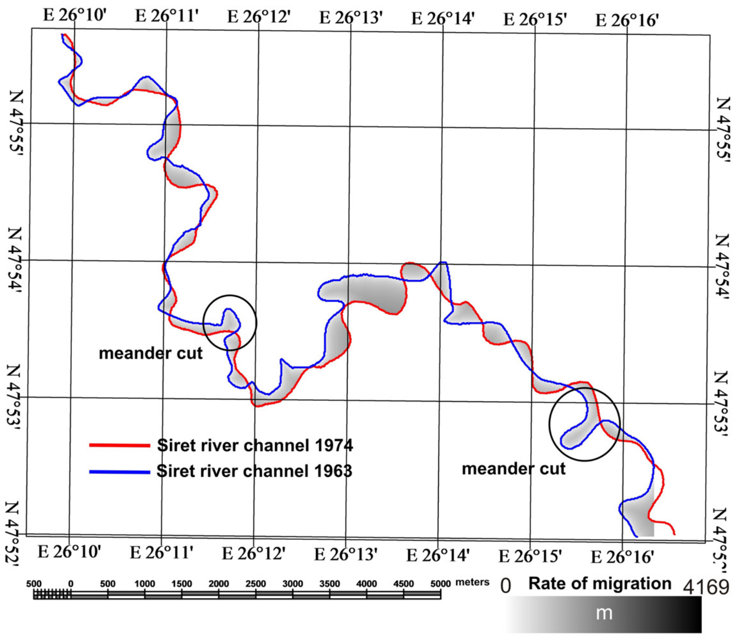

Figure 4. Raster representation of migration rates

Errors

Excluding the errors from the georeferencing and digitization process, the following errors may appear:

- the resolution related error in the conversion to raster, thinning and conversion to vector process,
- in graphical graph plotting errors may appear because of the values of the distance raster.

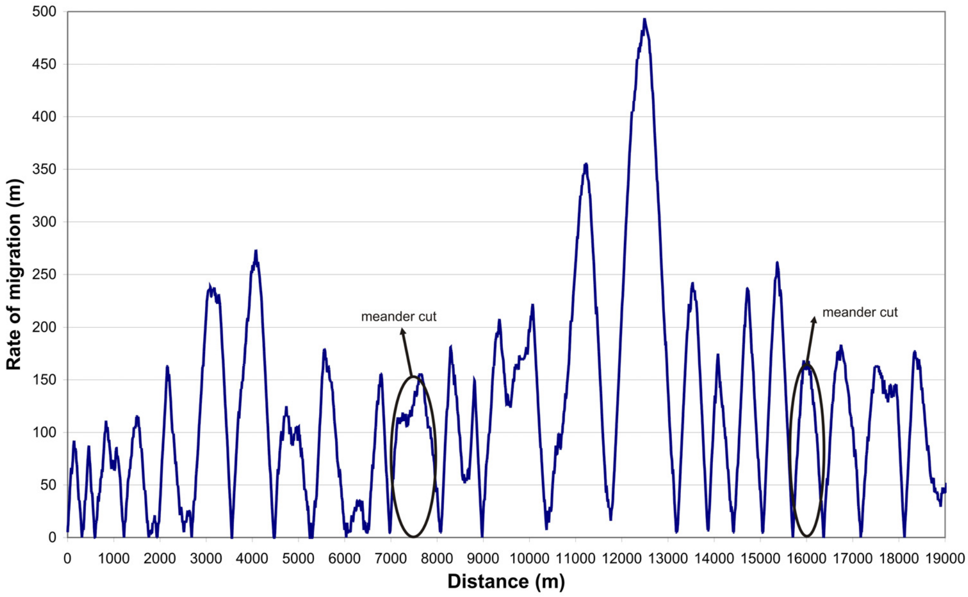

Figure 5. Graph plot representation of migration rates

Conclusions

The method showed here can be useful in the characterization of horizontal river channel evolution by lateral migration because speeds up the process of data acquisition and representation. Related to the old method (manual measurements on the topographic maps at various distances), this method can represents the rates of lateral migration of the river channel at short distances (1-100 m). This may be productive when using remote sensing products that show the evolution of a river channel at short periods of time.

Although this method is very productive, there is the need for improving some aspects. First, the raster format in the case of river pixels surrounded by non-river pixels should be a quadtree (for a rapid computation). Second, there is need for separating the rates of migration from right side of the channel from those to left side.

References

I. Ichim, Maria Rădoane, D. Bătucă, D. Duma - (1989) – *Morphology and dynamic of channel river.* Edit. Tehnică, Bucharest

TNTMips documentation, downloaded from www.microimages.com